FORM PTO-1082

Docket No. 6049

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Transmitted herewith for filing with the patent application of:

Inventor: Dean A. Klein

For: Backlighting System for an LCD

Enclosed are:

- x 16 pages of specification -- Claims 1 - 19
- x 8 sheets of informal drawings (8 Figures)
- x An assignment of the invention to Micron Electronics, Inc.
- ____ An associate power of attorney
- ____ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
- x Combined Declaration and Power of Attorney

The filing fee has been calculated as shown below:

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FOR:	NO. FILED	NO. EXTRA	RATE	FEE	OR	RATE	FEE
BASIC FEE				$385	OR		$770
TOTAL CLAIMS	19-20 =	---	x 11 =		OR	x 22 =	---
INDEP CLAIMS	3 -3 =	---	x 40 =		OR	x 80 =	---
MULTIPLE DEPENDENT CLAIMS			+ 130		OR	+240	____
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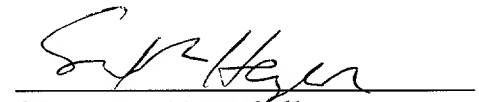
____ The issue fee set in 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

____ Any filing fees under 37 CFR 1 16 for later presentation of extra claims.

Date: 4-11-97



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SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, Dean A. Klein, a Citizen of the United States and a resident of Eagle, Ada County, ID, have invented certain new and useful improvements in a

BACKLIGHTING SYSTEM FOR AN LCD

of which the following is a specification.

BACKLIGHTING SYSTEM FOR AN LCD

Background of the Invention

1. Field of the Invention

The present invention relates generally to flat panel display systems. More particularly, the present invention relates to methods and apparatus for backlighting a liquid crystal display (LCD). Even more particularly, the present invention relates to backlighting a LCD on a laptop computer.

2. Description of the Prior Art

A conventional laptop computer, such as the laptop computer shown in Figure 1, utilizes a "fliptop" display to display computer data. The fliptop display is generally perpendicular to the body of the laptop computer when the laptop is in use, allowing the user to view the displayed computer data. When the laptop computer is not in use, the fliptop display is folded down into a closed position so that it is substantially parallel to the body of the computer.

The prior art fliptop display assemblies include a LCD housing. The LCD housing is typically hinged to the body of the laptop computer and generally operates as a protective cover for the LCD module.

Prior art fliptop displays also include an LCD module. The LCD module includes an LCD and a means for "backlighting" the LCD. Backlighting refers to generating light behind the LCD and uniformly projecting it through the LCD. Prior art backlighting techniques generally involve the use of a light source and a light pipe composed of light transmissive material located adjacent to the LCD. United

States Patent No. 5,050,946, which is incorporated herein by reference, discusses various light source and light pipe designs.

A cross sectional view of a conventional fliptop display **2** is shown in Figure 2. As shown in Figure. 2, the conventional fliptop display 2 includes an LCD housing **10** and an LCD module **15**. The LCD housing **10** is composed of an opaque material (usually plastic) and protects the LCD module **15**. The LCD module **15** is secured within the LCD housing **10** by various common securing means, such as screws, clips, or other frictionally engaging or interlocking means (not shown). Referring again to Figure 2, the LCD housing **10** has a rear portion **12** and top and bottom portions **11**.

Referring again to Figure 2, the LCD module **15** includes an LCD **20**, a light source **25**, and a light pipe **30**. The aperture **26** of the light source **25** is aligned adjacent to an end of the light pipe **30**. As shown in Figure 2, the light pipe **30** is adjacent to the back surface **21** of the LCD **20**. The LCD **20** is backlit when light generated by the light source **25** is conducted through the light source aperture **26** and coupled into an end of the light pipe **30**. As shown in U.S. Patent No. 5,050,946, the coupled light may be uniformly diffused throughout the light pipe **30**, and projected toward the back surface **21** of the LCD **20**. Some conventional LCD modules utilize a light pipe **30** with a light-reflective coating applied to the back side **31** of the light pipe **30** (not shown). In this manner, light incident upon the back surface **31** of the light pipe **30** will be reflected back into the light pipe **30** for projection toward the LCD **20**.

As shown in Figure 2, the length of the top and bottom portions **11** of the LCD housing **10**, and hence the depth **D** of the fliptop display **2**, are roughly defined by the combined thickness of the rear portion **12** of the LCD housing **10** and the LCD module **15**.

As shown in Figure 3, the depth **D** of the fliptop display **2** is at least the sum of the thickness **d1** of the rear portion **12** of the LCD housing **10**, the diameter **d3** of the light source **25**, and some fractional portion of the thickness **d5** of the LCD **20**. In situations where the diameter **d3** of the light source **25** is equal to the thickness **d4** of the light pipe **30**, the depth **D** may be the sum of the thicknesses **d1**, **d3** (or **d4**), and **d5**.

For example, thickness **d1** of the rear portion **12** of the LCD housing **10** may be 4 mm, the diameter **d3** of the light source **25** may be 4 mm and the thicknesses **d4** and **d5** of the light pipe **30** and the LCD **20** may be 2 mm. As shown in Figure 3, these dimensions will result in the light source **25** extending 1 mm on either side of the light pipe **30**. It can be seen that for this configuration of components, the depth **D** of the fliptop display **2** will be at least 9 mm and the thickness **d2** of the LCD module **15** will be 5 mm. In situations where the diameter **d3** of the light source **25** is equal to the thickness **d4** of the light pipe **30**, the depth **D** of the fliptop display **2** will be 8 mm and the thickness **d2** of the LCD module **15** will be 4 mm.

In the laptop computer industry, it is always desirable to reduce the size and weight of the laptop computer and its component parts. It is also desirable to

minimize the number of parts. Thus, there exists a need for a thinner, less complex, and lighter fliptop display.

Summary of the Invention

One embodiment of the present invention is a computer display. The computer display includes a LCD housing, a light source coupled to the LCD housing, and a LCD coupled to the LCD housing. In this embodiment, the LCD housing conducts light from the light source to the LCD.

Another embodiment of the invention is a method for conducting light. The method includes generating light and conducting the generated light through a LCD housing.

Brief Description of the Drawings

Figure 1 illustrates a perspective view of a laptop computer.

Figure 2 is a cross sectional view of a prior art fliptop display for a laptop computer.

Figure 3 is a close up view of the lower portion of Figure 2.

Figure 4 is a cross sectional view of a novel fliptop display of a laptop computer.

Figure 5 is a close up view of the lower portion of Figure 4.

Figure 6 is a close up view of an alternative embodiment of the lower portion of Figure 4.

Figure 7 is a cross sectional view of an alternative embodiment of the present invention.

Detailed Description of the Invention

Figure 4 illustrates a cross sectional view of a novel fliptop display **5**. The fliptop display **5** includes a planar LCD module **70** and a generally planar LCD housing **50**. The LCD module **70**, which includes a planar LCD **71**, is secured in the LCD housing **50** by various common securing means, such as screws, clips, or other frictionally engaging or interlocking means (not shown).

The LCD housing **50** is composed of a translucent material that functions as a light pipe. For example, the LCD housing **50** may be formed from an ABS plastic such as Lexan^{TM} from General Electric. The LCD housing **50** may include a planar rear portion **54** and top and bottom portions **55** As shown in Figure 4, a light source **60** may be partially embedded in or enclosed in the LCD housing **50**. The light source **60** may be secured in the LCD housing **50** by friction fit or by various common securing means, such as screws, clips, or other frictionally engaging or interlocking means (not shown). The LCD housing **50** may also have a light-reflective coating **53** applied to its outer surface **58**. The light-reflective coating **53**, may be composed of aluminum or a variety of metallic or other reflective substances. The light-reflective coating **53** reflects light incident upon it back into

the LCD housing **50** for projection to the LCD module **70**. The reflective coating **53**, when made of materials such as electroless chrome followed by 40 to 50 (inches of copper, then nickel plating of 10 (inches may also operate to minimize EMI emissions from the fliptop display **5**. Alternatively, a nickel-copper-nickel plating may be utilized. Because the reflective coating **53** forms the outer surface **58** of the housing **50**, it may be desirable to cover it or paint it with a protective layer **56** composed of a material such as soft touch polyethylene paint, that resists scratching and preserves its desired optical qualities.

During operation of the fliptop display **5**, the light source **60** generates light. This light is conducted through the LCD housing **50**. The conducted light is then projected into the back surface **72** of the LCD module **70**.

Figure 5 shows a close-up view of the lower portion of Figure 4. In Figure 5, the rear portion **54** of the LCD housing **50** has a thickness **d6**. The fractional portion of the LCD housing **50** between its outer surface **58** and the light source **60** has a thickness **d7**. (The light-reflective coat **53** and its protective layer **56** add a negligible thickness). The light source **60** depicted in Figure 5 is a cold cathode fluorescent lamp that has a diameter **d3**. For maximum light coupling, the cold cathode fluorescent lamp **60** may be embedded in the LCD housing **50** so that the aperture **61** of the cold cathode fluorescent lamp **60** is completely adjacent to the LCD housing **50**. The LCD module **70**, which has a thickness **d8**, may be adjacent to the inner surface **52** of the LCD housing **50**. Thus, it can be seen from Figure 5, that the depth **D** of the fliptop display **5**, closely approximates the sum of the thickness **d7** of the

fractional portion of the LCD housing **50** between its outer surface **58** and the light source **60**, the diameter **d3** of the light source, and some fraction of the thickness **d8** of the LCD module **70**. It can also be seen that the depth **D** of the fliptop display **5** closely approximates the sum of the thickness **d6** of the rear portion **54** of the LCD housing **50** and the thickness **d8** of the LCD **71**.

For example, using the dimensions previously discussed for these components, the thickness **d8** of the LCD **71** is 2 mm and the thickness **d6** of the LCD housing **50** is 4 mm. To provide maximum light coupling, the light source **60** with a 2 mm aperture **61** will be embedded in the LCD housing **50** so that 1 mm of diameter protrudes from the assembly. Accordingly, the thickness **d7** will be 1 mm, and the fraction of the thickness **d8** contributing to the depth **D** of the fliptop display **5** will be 1 mm. Thus, it can be seen that the depth **D** of the fliptop display **5** is now 6 mm. This depth **D** is 25% less than the depth of conventional fliptop displays.

Another embodiment of the present invention is shown in Figure 6. This embodiment, includes an omnidirectional light source **62**. A reflector **63** is used to direct incident light generated by the omnidirectional light source **62** back into the LCD housing **50**. As shown by the path traveled by light ray **A**, the light-reflective coating **53** will internally reflect light conducted into the bottom portion **55** of the LCD housing **50** until the light is eventually directed toward the rear surface **72** of the LCD module **70**. Since all internal reflections will inherently have a lossy effect on the incident light, the junction of the rear portion **54** and the bottom portion **55** of the LCD housing **50** may be geometrically shaped so that light is reflected into the

rear portion **54** with a minimum amount of internal reflections. In this embodiment, the light source **62** need not be enclosed in the LCD housing **50** to the extent of the cold cathode fluorescent lamp **60** of Figure 5. In situations where a greater thickness **d7** is required to protect the light source **62**, the light source **62** may be enclosed in the LCD housing **50** at a variety of depths.

Still another embodiment of the present invention is shown in Figure 7. In this embodiment, the light source **62** and the reflector **63** may be located in the middle of the rear portion **54** of the LCD housing **50**. The light source **62** may be partially enclosed in the LCD housing **50**. The protrusion of the light source **62** (and the reflector **63**) from the LCD housing **50** creates a gap **66** between the rear surface **72** of the LCD module **70** and the inner surface **52** of the LCD housing **50**. This results in a larger gap **66** than required solely to accommodate the protrusion of the light source **62** from the LCD housing **50**.

The gap **66** may be purposely designed into the fliptop display **5** as a design tradeoff between depth **D** and lighting efficiency. While the depth **D** of the fliptop display **5** will be increased, lighting efficiency may be improved. The addition of the gap **66** will provide the light with a greater depth **d** in which to diffuse before being incident upon the rear surface **72** of the LCD **71**. This may provide better illumination of the LCD **71** toward the top and bottom portions **55** of the LCD housing **50**.

Yet another embodiment is shown in Figure 8. In this embodiment, the thickness **d6** of the rear portion **54** of the LCD housing **50** in Figure 7 may be

increased in order to strengthen the LCD housing **50**. For example, using the typical dimensions previously discussed for the various fliptop display components, the thickness **d6** may be increased up to 2 mm before the fliptop display **5** has the same depth **D** as in the prior art. As shown in Figure 8, the depth **d** of the gap **66** is correspondingly reduced.

In yet another embodiment, the LCD housing **50** can be designed to display a variety of ornamental effects. In this embodiment, areas of the light-reflective coating **53** can be masked or removed by scoring or by etching so that light incident upon these areas is no longer reflected back into the LCD housing **50**, but instead is conducted out of the LCD housing **50**. The protective layer **56** would also typically be similarly scored or etched in order to allow the light to leave the LCD housing **50**. In this manner, text, company logos, trademarks, or other designs may be illuminated.

With respect to the embodiments described herein, it can be seen that the present invention's incorporation of the light pipe function into the LCD housing provides the laptop computer designer with greater design flexibility. The potential reduction in depth **D** of the fliptop display provides the laptop computer designer with a variety of configurations for the light source, LCD, and LCD housing assembly. The laptop computer designer may configure these components in a variety of ways resulting in a fliptop display depth **D** that is less than or equal to the width of the prior art fliptop display assembly. Additionally, the size and/or weight of the LCD module may substantially reduced. While this design flexibility has been

demonstrated in the description of the preferred embodiments, it is clear that many other modifications, changes, variations, and substitutions are within the scope of this invention.

Claims

What is claimed is:

1. A computer display comprising:

a LCD housing;

a light source coupled to the LCD housing;

a LCD coupled to the LCD housing;

wherein the LCD housing conducts light from the light source to the LCD.

2. The computer display of claim 1 wherein the light source is at least partially enclosed in the LCD housing.

3. The computer display of claim 2 wherein the LCD housing includes a reflectively coated outer surface, and wherein light is reflected by the reflectively coated outer surface.

4. The computer display of claim 3 wherein the reflectively coated outer surface is comprised of a material that attenuates EMI emissions.

5. The computer display of claim 4 wherein the LCD housing includes an inner surface and the LCD is adjacent to the inner surface.

6. The computer display of claim 5 wherein the light source is a cold cathode fluorescent lamp.

7. The computer display of claim 6 wherein the reflectively coated outer surface includes a metallic coating.

8. The computer display of claim 4 wherein the LCD housing includes an inner surface, the light source is at least partially enclosed in the LCD housing such that a gap exists between the LCD and the inner surface of the LCD housing assembly, and wherein light from the LCD housing is conducted through the gap.

9. The computer display of claim 8 wherein the light source is a cold cathode fluorescent lamp.

10. The computer display of claim 9 wherein the reflectively coated outer surface includes a metallic coating.

11. The computer display of claim 4 wherein the light source is substantially enclosed in the LCD housing assembly.

12. The computer display of claim 11 wherein the light source is a cold cathode fluorescent lamp.

13. The computer display of claim 12 wherein the reflectively coated outer surface includes a metallic coating.

14. The computer display of claim 1 wherein the LCD housing includes a surface that is partially covered with a light-reflective coating.

15. The computer display of claim 1 wherein the LCD housing includes an outer surface that partially conducts light out of the LCD housing.

16. A computer comprising;

a display panel;

means for generating light for the display panel; and

means for housing the display panel and for conducting light between the means for generating light and the display panel.

17. A method for conducting light comprising;

generating light; and

conducting the generated light through a LCD housing.

18. The method of claim 17 wherein the step of generating light includes generating light with a cold cathode fluorescent lamp.

19. The method of claim 17 wherein the step of conducting the generated light includes conducting the generated light through a LCD housing that is coated with a coating that reduces EMI emissions.

Abstract of the Disclosure

A computer display is disclosed. The computer display includes a LCD housing, a light source coupled to the LCD housing, and a LCD coupled to the LCD housing. The LCD housing conducts light from the light source to the LCD. A method for conducting light is also disclosed. The method includes generating light and conducting the generated light through a LCD housing.

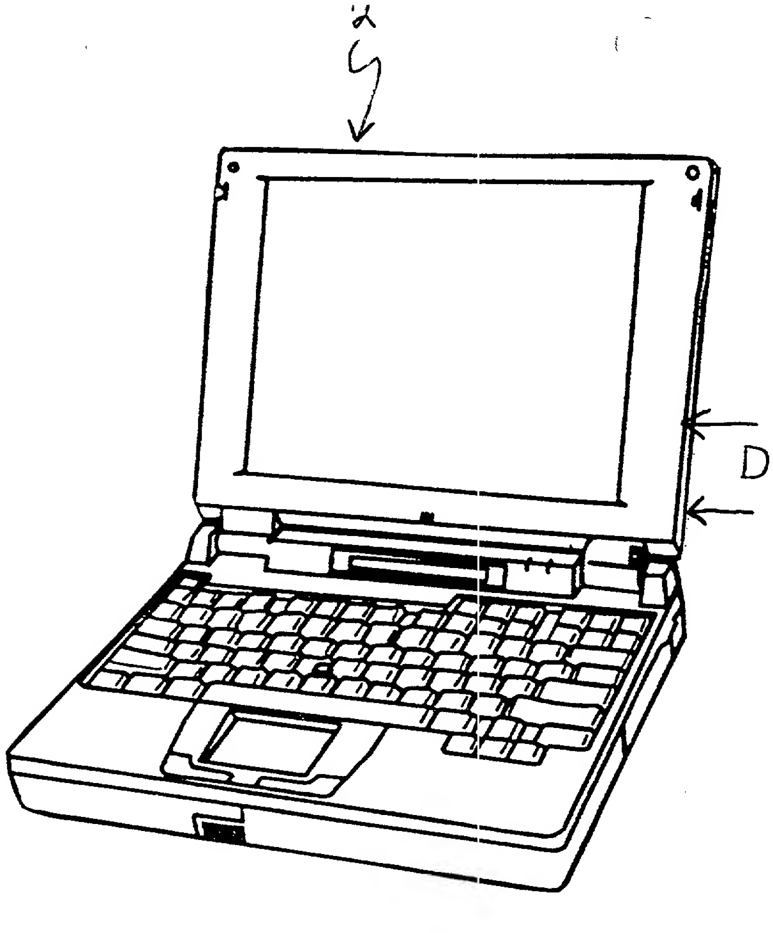


Fig. 1
(Prior Art)

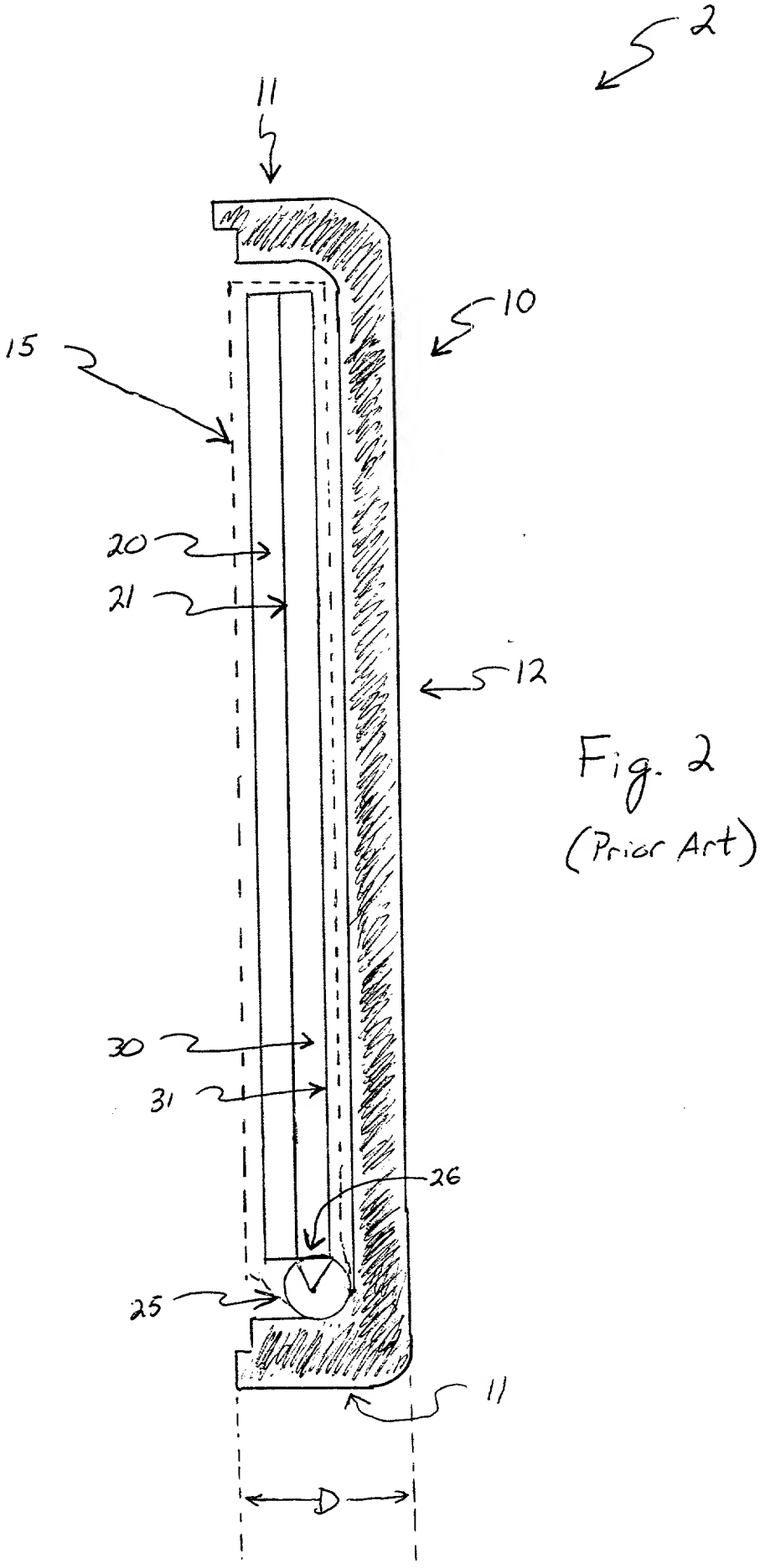


Fig. 2
(Prior Art)

Fig. 3 (Prior Art)

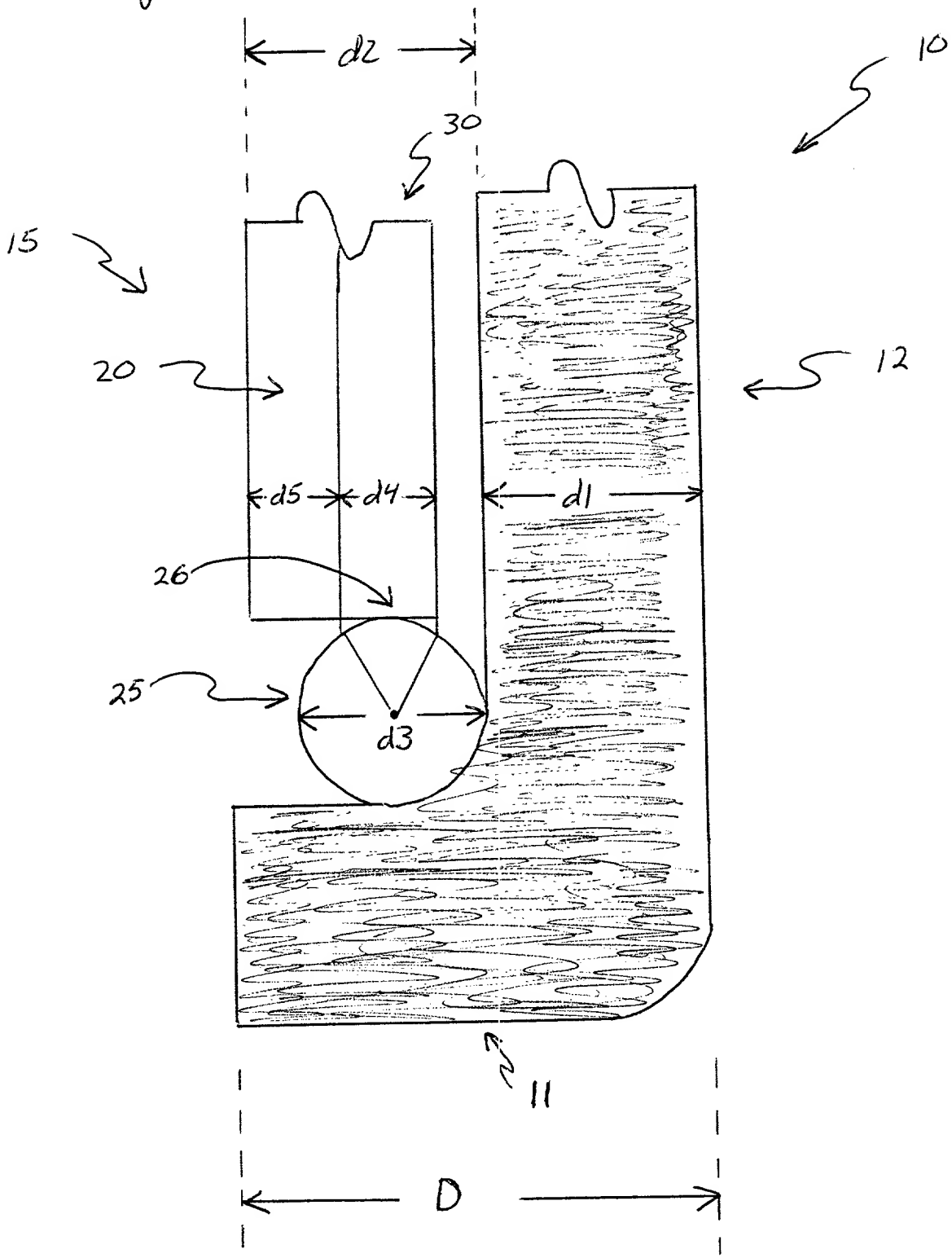


Fig. 4

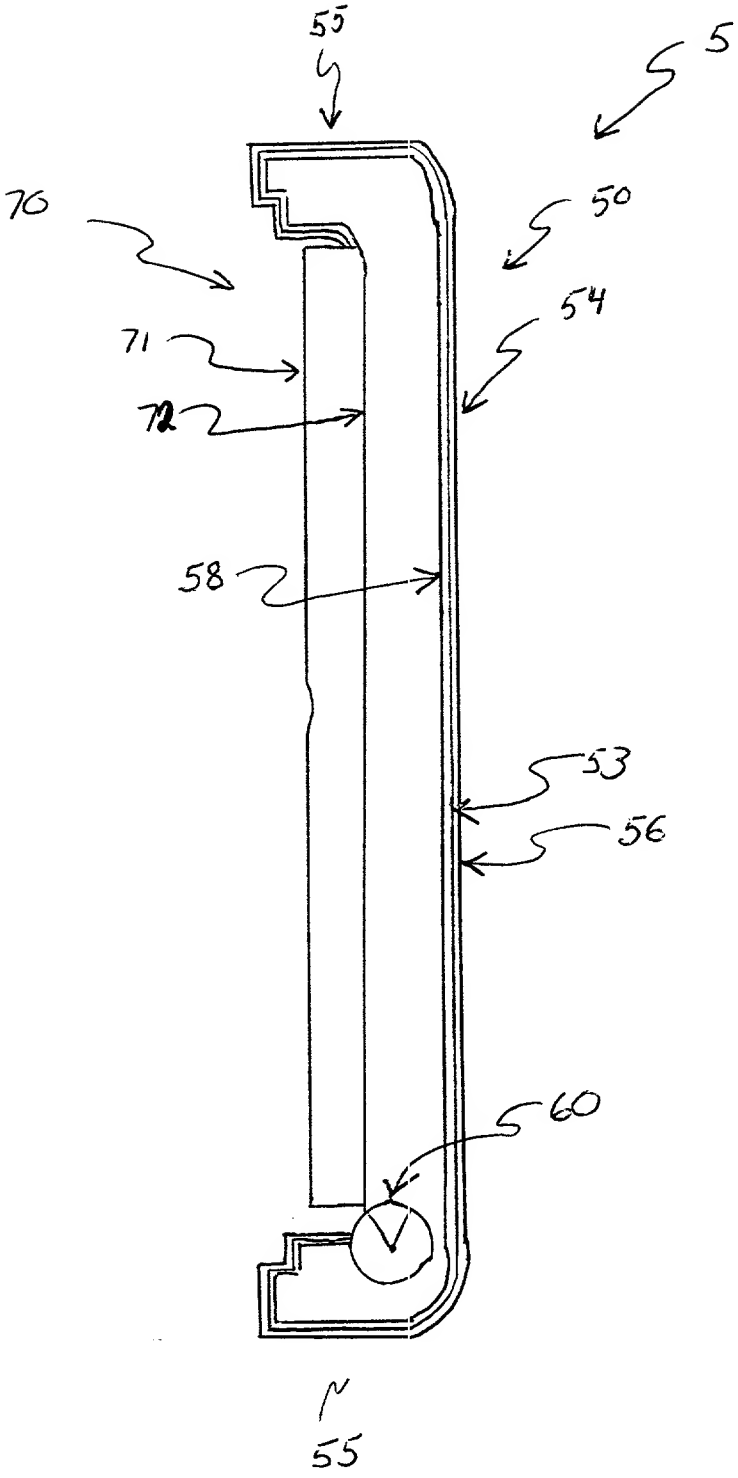


Fig. 5

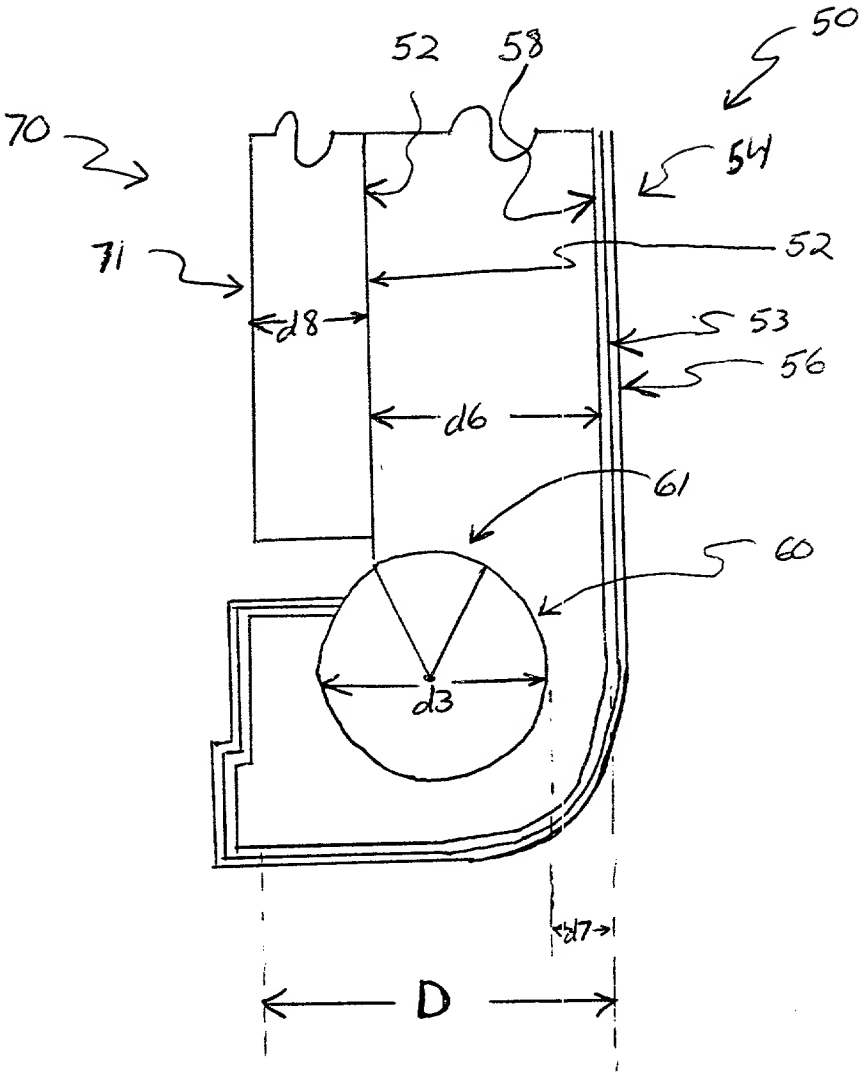


Fig. 6

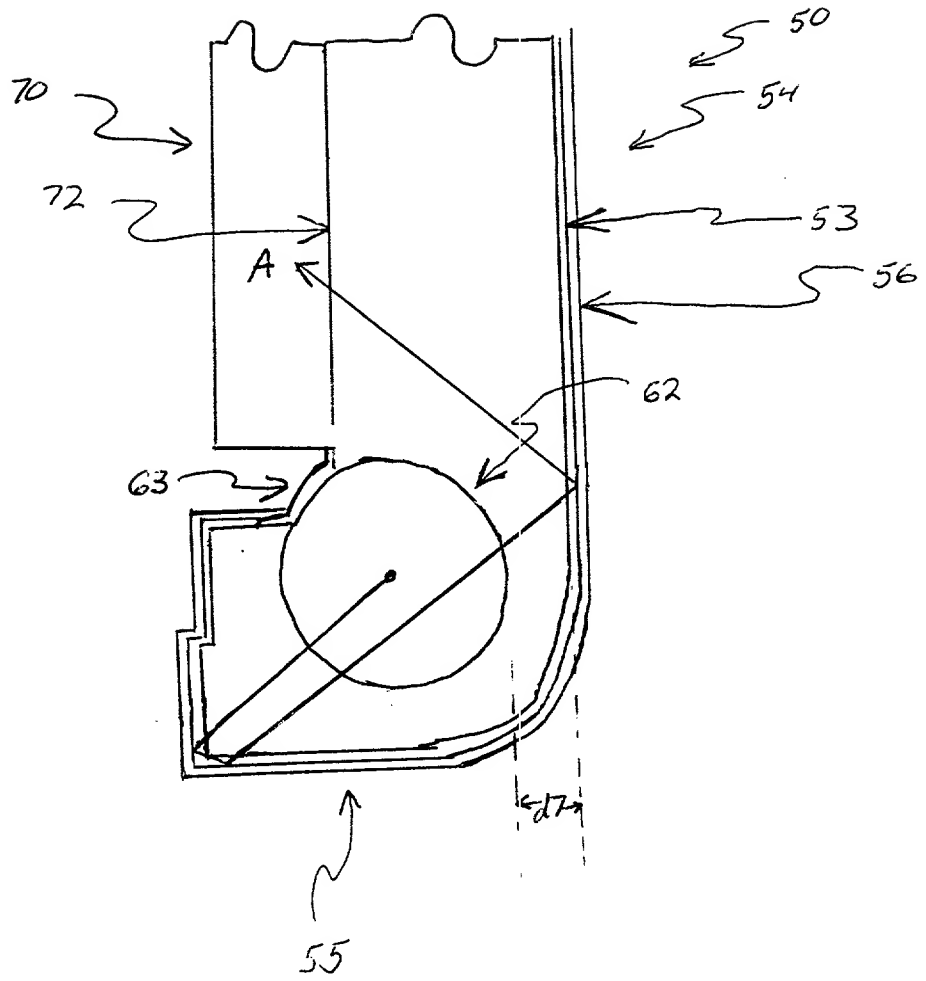


Fig. 7

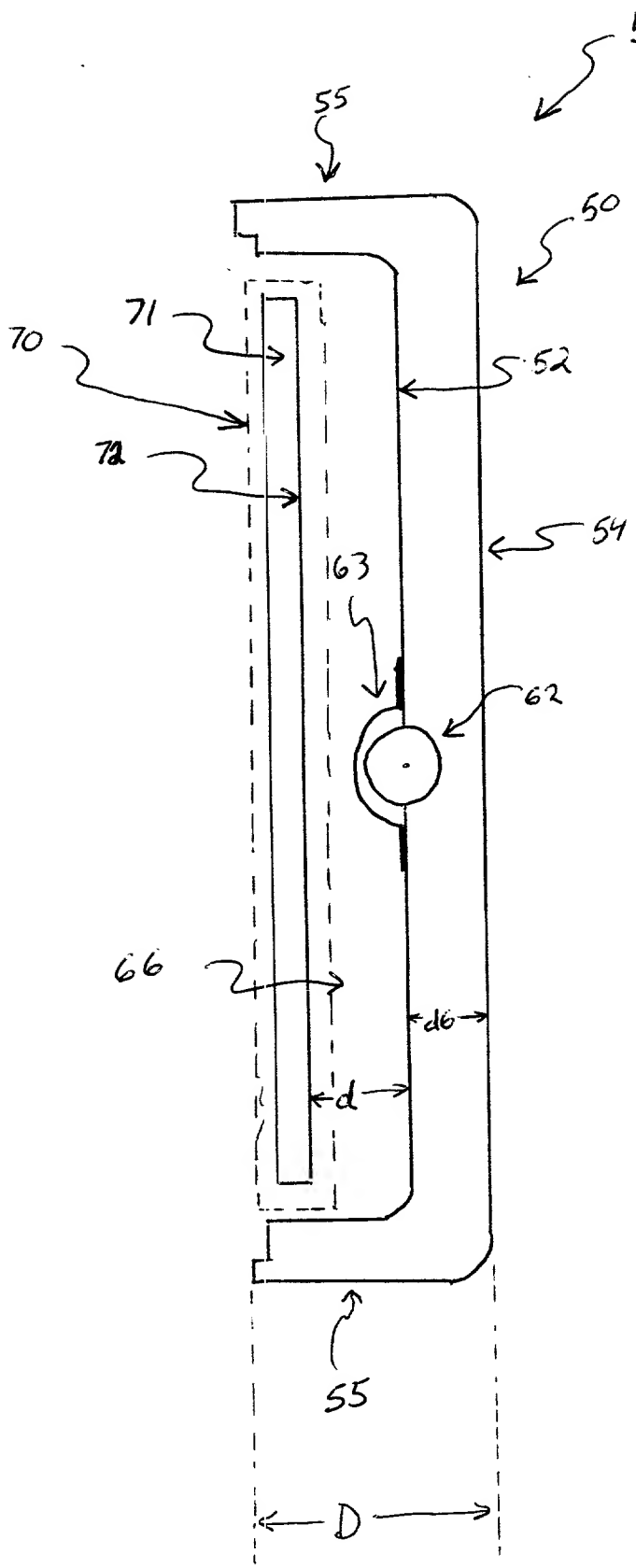
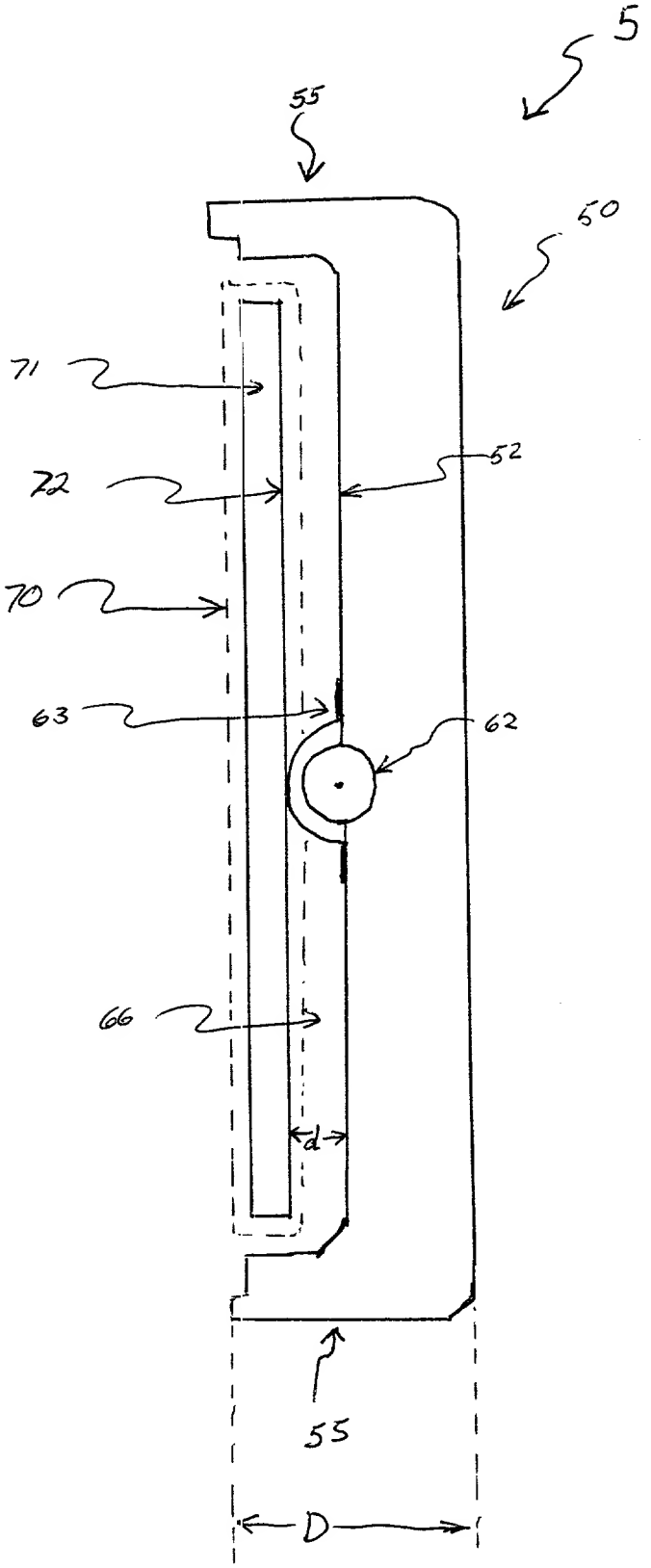


Fig. 8



Docket No. 6049

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Backlighting System for an LCD

the specification of which

__x__ is attached hereto.

_____ was filed on _____ as application Serial No. _____ and was amended on _____.

I hereby state that I have reviewed and understand the contents of the specification, including the claims, as amended by any amendment referred to herein.

I acknowledge the duty to disclose all information known to me to be material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIORITY FOREIGN APPLICATION(S)

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application:

(Application Serial No.)	(Filing Date)	(Status)
(Application Serial No.)	(Filing Date)	(Status)

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Ronald J. Brown (29,016), David E. Bruhn (36,762), David N. Fronek (25,678), Stuart R. Hemphill (28,084), Eugene L. Johnson (21,028), Devan Padmanabhan (P38,262), James Rogers (37,228), Gerald Sullivan (37,243), Jon F. Tuttle (25,713), Mark A. Wolfe (36,311), Erik R. Nordstrom (P39,792) and Kenneth E. Levitt (P39,747) and Steve Arnold (33,354).

Direct all telephone calls to: Stuart R. Hemphill (612/340-2734)

Address all correspondence to: Stuart R. Hemphill at Dorsey & Whitney LLP, 220 South Sixth Street, Minneapolis, Minnesota 55402.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful

false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: april 4, 1997 Inventor: Dean A Klein

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